ASSESSMENT OF PEST AND DISEASE STATUS OF EARLY GROWTH OF *SHOREA* SPP.

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ABSTRAK

Kerusakan yang disebabkan oleh patogen, serangga dan faktor-faktor lain, secara sendiri atau bersama dapat mempengaruhi pertumbuhan dan perkembangan anakan pohon atau permudaan hutan. Penilaian dan pencatatan status kerusakan secara terus menerus, memungkinkan pertumbuhan anakan pohon dan permudaan hutan dapat dievaluasi. Di samping itu juga akan diketahui kemungkinan penyebab penyimpangan yang terjadi. Penelitian ini bertujuan untuk mengembangkan sistem penilaian dan pencatatan status hama dan penyakit pada pertumbuhan anakan pohon jenis-jenis Meranti yang ditanam mengikuti beberapa sistem tanam pada percobaan rehabilitasi hutan tropis di hutan pendidikan Jambi.

Tanda dan gejala kerusakan yang mempengaruhi pertumbuhan dan yang mematikan digunakan sebagai parameter penilaian. Kerusakan digolongkan secara bertingkat menurut bagian dari anakan (lokasi) yang menderita kerusakan (lokasi), dan tingkat kerusakan pada tiap lokasi diukur berdasarkan proporsi organ yang rusak.

Pengamatan di lapangan menunjukkan bahwa terdapat perbedaan status hama dan penyakit anakan pohon Meranti pada sistem penanaman yang berbeda. Kerusakan ini terjadi terutama disebabkan oleh perubahan struktur hutan dan kondisi lingkungan pada sistem penanaman. Kematian anakan pohon tertinggi (11,85%) terjadi pada tanam jalur di bawah vegetasi Makaranga dan kematian terendah diamati pada sistem tanam rumpang (2,27%). Kematian tunas ujung yang menyebabkan percabangan majemuk dan kerusakan bentuk batang adalah kerusakan yang utama juga dijumpai pada sistem tanam jalur di bawah vegetasi Makaranga, yaitu sebesar 45,80%. Cabang patah atau mati dan kerusakan daun adalah kerusakan lain yang terjadi pada anakan pohon pada sistem penanaman dengan intensitas yang berbeda-beda. Sistem penilaian ini dapat digunakan untuk mengevaluasi status hama dan penyakit pada saat pengamatan dilakukan. Sistem penilaian ini juga dapat digunakan untuk meramalkan perkembangan anakan pada tingkat-tingkat pertumbuhan selanjutnya.

Kata Kunci: evaluasi, hama, penyakit, shorea spp

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INTRODUCTION

Interest in rehabilitating tropical rain forests is increasing. Several factors that can be mentioned as the reason why the interest of tropical rain forest rehabilitation is increasing are (1) past and continuing destruction of natural forest, (2) problems of access to existing forest, and (3) unsatisfactory natural regeneration. On the other hand it is realised that tropical forest has its significant role not only in future world wood supply, but in controlling the envinronment as well. Forests have a vital role to play regulation of atmospheric CO_2 and moderating negative consequences of fossil fuel burning. Forest also contribute a major storage of carbon that can be used as the source of energy for many organisms. Tropical deforestation is believed to be the main agent causing a significant reduction on the role of forests as the resource of future wood supply and environment regulator.

Silvicultural systems have been applied in planting programes on logged over areas, grass land and other devastated tropical rain forest. In areas where natural regeneration are found to be unsatisfactory, it can be a suplement following line planting or group planting systems using the desired species. In Indonesia, *Shorea* spp. is one among the prospective species to be planted to rehabilitate tropical rain forest. Various planting systems has been developed for tropical forest rehabilitation. Enrichment of forest regeneration by planting tree seedling have been applied in many places to rehabilitate tropical rain forest. One of the attributed specific interest of the existing and desired forest community is the agents that might harm individual trees or affect the health and life of an entire community (Nyland, 1996).

Damage caused by pathogens, insects and other man-made activities, either singly or in combination can affect the growth of regeneration seedlings. The damage of forest regeneration can eventually affect the forest health and development. The nature of disturbed forest, its unbalance ecological system, renders it to be more susceptible to some forms of the damage. Disease, pest and other forest damage are generally unpredictable, irregular, not always easily detected at first and varied severely. Damage even can be catastrophic. That is way serious problem, though not obviously catastroriphic, can pass unnoticed for long time in the forest. Detection of damage is the first main step in managing the disease and other damage protection problem. Identifying the signs and symptoms of damage provides valuable information concerning the forest's conditions. It is important to note that "detection" concentrate on the damage to the regeneration or tree which is first observed rather than on the causal agents such as the insect, pathogen or fungal fruiting body. The experiment was conducted to develop scoring system of damage on regeneration.

MATERIALS AND METHODS

Time and Location

The experiment was held in tropical rain forest in Jambi, in January 1999, where planting systems of *Shorea* spp. were applied in the previous experiments set up by GMU-KEEC project. The trial plantation was established in The Research and Education Forest of Gadjah Mada University (GMU) located at the middle district of Batanghari river basin, Jambi (102^0 30". $1^0$33").

Sampling Plots

Sampling plots were set up in four different planting systems. The form, size and number of plots established were varies and dependent upon the nature of existing planting systems. In line and strip planting systems measurement was made in line plots, whereas in the other planting systems we used square plots.

1. Strip planting with nurse planting system

Dipterocarp seedlings were planted in rows within the rows of exotic tree species as nurse plants. Four species of nurse plants (*Acacia mangium, Paraserianthes falcataria, and Gmelina arborea*), which consists of 4 rows each, were planted randomely in two blocks with 3 replications for every block. The nurse plants were planted in January 1994 and the dipterocarp seedlings were planted in February 1995. Weeding were carried out together with seedling growth evaluation, in June & November 1995, June & November 1996, and June 1997 (Hardiwinoto, 1996). Centre row of the three rows of dipterocarp seedling in all strips of nurse plants was selected as the sampling units.

2. Line planting system

a. Under natural forest

The existing planting systems consist of two different sets of 500 m lines of dipterocarp plantation under natural forest, with 3 lines each. In the first type, the dintance between rows is 5 m, whereas in the second type the distance between rows is 10 m. Two separate sampling units of 100 m located in the opposite edges of each line, were used for assessing pest and disease

b. Under Macaranga

In this planting system, dipterocarp seedlings were planted in rows with 5 m distance between row. Two sampling units, which consist of 3 lines each, located on the opposite end of planting area were used to assess pest and disease status of the seedling.

3. Gap planting system

In this experiment three different size of gap planting systems were used (Okimori *et al.*, 1996), i.e. 40mx40m, 20mx20m and 10mx10m. All dipterocarp seedlings planted in the gaps with 2 replications were recorded for pest and disease assessment.

4. Natural regeneration

Pest and disease assessment of dipterocarp seedling in natural regeneration was evaluated in the existing permanent regeneration plot. Nine square sub-plots (5x5 m), no. 1; 5; 10; 50; 55; 60; 91; 95; 100, were used to evaluate the seedling damage.

Procedures

Damage signs and symptoms were recorded on the live seedling and small sapling. Damage signs and symptoms were recorded if, by definition, the damage could kill the seedling or affect the long term survival of the seedling. The seedling and small sapling were observed from all side and the damage was recorded based on location in the following order: stem, branch and foliage.

Within any given location, the hierarchy of damage follows the numeric order of damage types possible for that location. The numeric order denotes decreasing significance as the code number goes down, i.e., damage 3 is more significant then damage 1. Mortality of seedling was recorded. Dead seedling or small sapling was recorded as the sign of catastrophic events due to both biotic and abiotic agents

Specific causal agents were not identified as the goal of the experiment in the detection of changes. However, if specific causal agent of damage or mortality could be identified, the agent was included in the notes section for individual sample.

Determining and Coding Damage by Location

The score system was modified from the method proposed by Forest Health Monitoring (Mangold, 1997). Damage signs and symptoms are prioritized and recorded based on location in the following order: stem (A), branch (B), and foliage (C). Within any given location, the hierarchy of damage follows the numeric order of damage types possible for that locations. The numeric order denotes increasing significance as the code mumber goes up, i.e. damage 04 is more significance than damage 02.

Code	Location
A	Stem; dead of apical dominance with or without new stem (figure 1).
	A1 no shoot damaged
	A2 dead shoot at the lower stem (20 cm above ground)
	A3 dead shoot at the middle stem
	A4 dead shoot at the upper stem.

A5 all stem died

B Branches initiated from the main stem (figure 2)

B1 no damaged branch(s)

B2 damaged branch(s) attached to the upper stem

B3 damaged branch(es) attached to the middle stem

B4 damaged to all branches

C Foliage (figure 3)

C1 damaged leaves less than 25%

C2 leaves damaged of 25%-50% of total foliage

C3 leaves damaged of 50%-75% of total foliage

C4 leaves damaged more than 75% of total foliage

RESULT AND DISCUSSION

Mortality

Obvious signs of catastrophic agents causing mortality to seedling and small sapling were observed in all planting system areas, though the number varied. It was indicated from Table 1 that the biggest percentage of dead seedling and small sapling was 11.85% and this was found in line planting system under macaranga. Dead seedling or sapling were generally dried up with varying number of dry foliage and branches left (Fig. 4). The proportion of dry foliage on dead seedling or small sapling is a valuable guide for postdating mortality. For example foliage is usually absent after 2 years or even sooner in dead seedling of shorea. It means that the dead seedlings recorded in this experiment were those died since 1.5 years ago (Anonymous, 1997). Seedlings died before the time periode usually have broken and this was exluded from the observation.

Cause of death was not easy to be identified and it might be biotic and/or abiotic agents. Close observation of some dead seedling indicated that compactness of soil used as the growth medium of seedling in nursery was the cause of death. It was suggested from the signs recorded that seedling mortality might be caused by pest and disease, weather, suppression/competition and soil condition.

Damage

Damage on stem

The death of apical dominance was the common damage recorded on the seedling in all plots with different planting systems. In most cases new apical shoot took over the dead one, and the new apical dominance grew above the old fork (Fig. 4).

Table 1 The proportion of dead seedling and small sapling on areas where different planting system were applied.

Planting system			Dead seedling (%)
Strip planting with nurse plant :			
	a. Mangium/Mangium		3.20
	b. Mangium/Albizia		8.11
	c. Albizia/Albizia		5.26
	d. Albizia/Gmelina		0.00
	e. Gmelina/Gmelina		4.84
	f. Gmelina/Mangium		21.20
		Average	7.10
Line planting :			
1. Under natural forest			
	a. Type 1		0.40
	b. Type 2		4.80
		Average	2.60
2. Under Macaranga			11.85
Gap planting :			
	a. 20m x 20m		5.30
	b. 30m x 30m		0.60
	c. 40m x 40m		0.90
		Average	2.27
Natural regeneration			4.60

This type of damage could repeately occurred in a single seedling at different hight from ground level. It is suggested base on the sign that pathogen or insect attack might be the main causal agent of the death of apical dominance. Table. 2 summaries the damage recorded in the areas of different planting systems.

Other damages recorded on stem were wound, insect attack and other mechanical damage. It was indicated from Table 2 that the bigest percentage of dead apical dominance at the height up to 20 cm above ground (Fig. 1) was in nurse planting system (12.59%). This proportion was followed by line planting under natural forest, line planting under Macaranga, natural regeneration and gap planting, which indicated the percentages of damage, 11.00%, 9.20%, 9.10%, 8.03% respectively.

The percentage of dead apical dominance at the middle stem above ground (Fig. 1a) was observed in line planting under natural forest (32.35%), and this followed by natural regeneration (31.8%), gap planting (25.15%), nurse planting (18.42%), line planting under Macaranga (17.95%). The percentage of the same damage but occurred at the upper stem (Fig. 2) were 45.8% (line planting under Macaranga), 41.0%% (line planting under natural forest), 40.9 % (in natural regeneration), 38.07% (in gap planting), 30.30 % (in nurse planting).

It was indicated from the data above that at any location, the biggest loss occurred on the upper stem of seedling.

Table 2. The death of apical dominance of *Shorea* spp. seedling planted following different planting systems (percentage to seedling observed).

Planting system	Hight of damage above ground level (%)		
	Lower stem (A2)	Middle stem (A3)	Upper stem (A4)
Nurse planting :			
a. Mangium/Mangium	14.81	11.11	37.04
b. Mangium/Albizia	10.81	29.73	35.14
c. Albizia/Albizia	10.53	14.03	43.86
d. Gmelina/Albizia	10.34	27.59	34.48
e. Gmelina/Gmelina	4.84	12.90	16.13
f. Gmelina/Mangium	24.24	15.15	15.15
Average	**12.59**	**18.42**	**30.30**
Line planting :			
1. Under natural forest			
a. Type 1	9.50	32.70	42.20
b. Type 2	12.50	32.00	39.80
Average	**11.00**	**32.35**	**41.00**
2. under Macaranga	**9.20**	**17.95**	**45.80**
Gap planting :			
a. 20m x 20m	6.90	26.00	41.20
b. 30m x 30m	4.00	22.70	48.70
c. 40m x 40m	13.20	24.90	24.30
Average	**8.03**	**24.50**	**38.07**
Natural regeneration	**9.10**	**31.80**	**40.90**

Damage on branches

Dead branches on seedling will reduce the capacity of seedling to assimilate due to the loss of foliage carried on the branches. Drying out was the common sign of damage observed on the branch of seedling. The damage was catagorized based on the position of the branch on stem. Table 3 shows the severity of damage on branch of seedling in the areas where different planting system were applied.

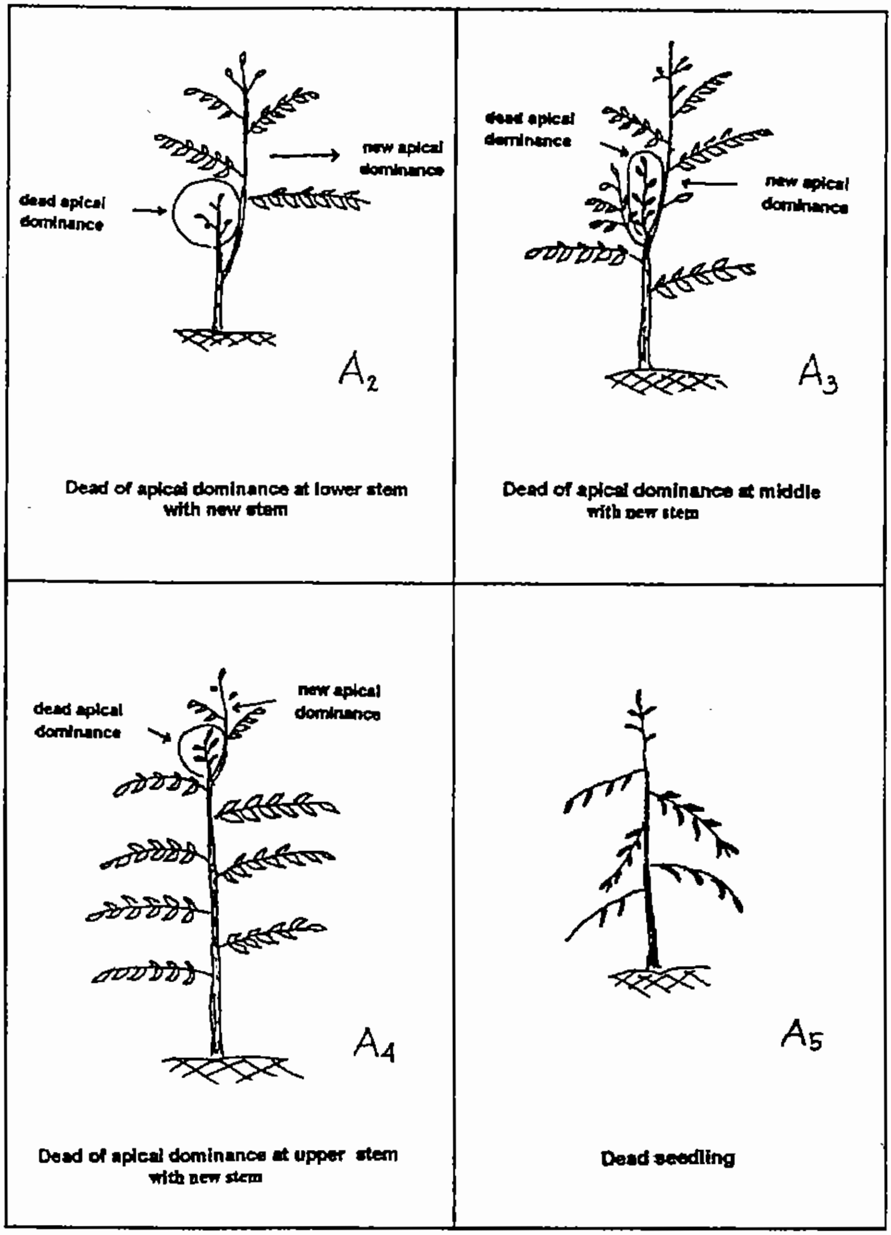

Figure 1. Diagramatic illustration indicating scoring system used for damages on the stem part of seedling (see scoring system)

Table 3 The damaged branch of *Shorea* spp. seedling planted following different planting systems (percentage to seedling observed).

Planting system	Percentage of damaged branch		
	at upper stem (B2)	at middle stem (B3)	at all stem (B4)
Nurse planting :			
a. Mangium/Mangium	2.50	20.00	2.50
b. Mangium/Albizia	8.82	11.76	0.00
c. Albizia/Albizia	0.00	29.63	0.00
d. Albizia/Gmelina	0.00	27.59	0.00
e. Gmelina/Gmelina	1.69	16.95	0.00
f. Gmelina/Mangium	0.00	19.23	0.00
Average 2.17	20.86	0.42	
Line planting :			
1. Under natural forest			
a. Type 1	7.70	49.30	0.70
b. Type 2	5.70	38.50	0.90
Average 6.70	43.90	0.80	
2. Under Macaranga:	5.30	41.15	1.75
Gap planting :			
a. 20m x 20m	16.10	17.00	0.00
b. 30m x 30m	18.70	24.50	0.00
c. 40m x 40m	3.60	26.00	0.40
Average 12.80	22.50	0.13	
Natural regeneration	0.00	77.30	0.00

Same with the damages on the stem, other damages recorded on branch were wound, insect attack and other mechanical damage. It was indicated from Table 3 that the bigest percentage of damages on the branch attached to the upper stem (Fig. 2) was in gap planting system under natural forest (12.80%). This proportion was followed by line planting under natural forest, line planting under macaranga, nurse planting and natural regeneration, which indicated the percentages of damage, 6.70%, 5.30%, 2.17%, 0.00% respectively.

The percentage of damage recorded on branch attached to the middle stem (Figure 2) was observed in natural regeneration (77.30%), and this followed by line planting under natural forest (43.90%), line planting under macaranga (41.15%), gap planting (22.50%) and nurse planting (20.86%), The percentage of same damage but occurred to all branches (Figure 2) were 1.75% (line planting under Macaranga), 0.80%% (line planting under natural forest), 0.42 % (in nurse planting), 0.13% (in gap planting), 0.00 % (in natural regeneration).

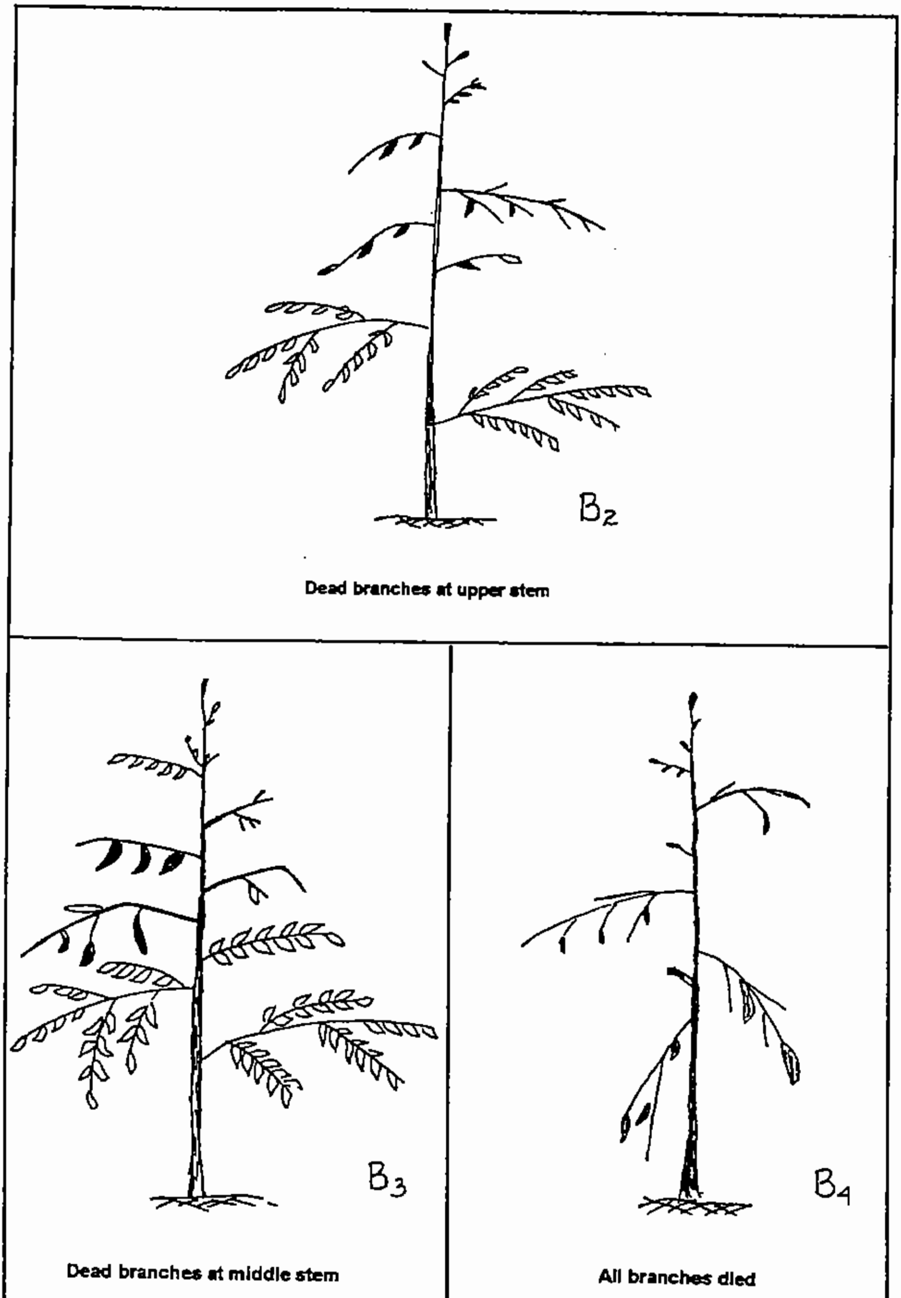

Figure 2. Diagramatic illustration indicating scoring system used for damages on the branch part of seedling (see scoring system)

It was indicated from the data above that at any location, the biggest loss occurred on the midle stem of seedling.

Damage on foliage

Defoliation was the main sign recorded and the damage was coded based on the percentage of dead leaf observed. Insect was the common agent of damaging leaves. The results of the observation of leaf damage was summarized in Table 4.

Table 4 : Damages developed on the leaves of shorea seedling in different planting systems of regeneration

Planting system		Leaf damage		
	< 30 % (C1)	30 - 50 % (C2)	50 - 75 % (C3)	75 % < (C4)
Nurse planting :				
a. Mangium/Mangium	90.00	8.00	0.00	2.00
b. Mangium/Albizia	91.18	5.88	0.00	2.94
c. Albizia/Albizia	88.88	11.12	0.00	0.00
d. Albizia/Gmelina	65.52	24.14	6.89	3.45
e. Gmelina/Gmelina	76.27	20.34	3.39	0.00
f. Gmelina/Mangium	96.15	3.85	0.00	0.00
Average	84.67	12.22	1.71	1.39
Line planting :				
1. Under natural forest				
a. Type 1	25.40	21.80	19.70	33.10
b. Type 2	11.50	9.80	19.70	59.00
Average	18.45	15.80	19.70	46.05
2. Under Macaranga:	43.00	14.80	24.00	18.20
Gap planting				
a. 20m x 20m	43.90	46.30	8.90	0.90
b. 30m x 30m	23.40	43.50	23.40	9.70
c. 40m x 40m	58.70	28.50	8.10	4.70
Average	42.00	39.43	13.47	5.1
Natural regeneration	28.60	33.30	28.60	9.50

It was concluded that the seedlings planted following line planting under natural forest system sufferred leave damage the most (C4-46.05%). This proportion was followed by line planting under macaranga, natural regeneration, gap planting and nurse planting, which indicated the percentages of damage, 18.20%, 9.50%, 5,1%, 1.39% respectively.

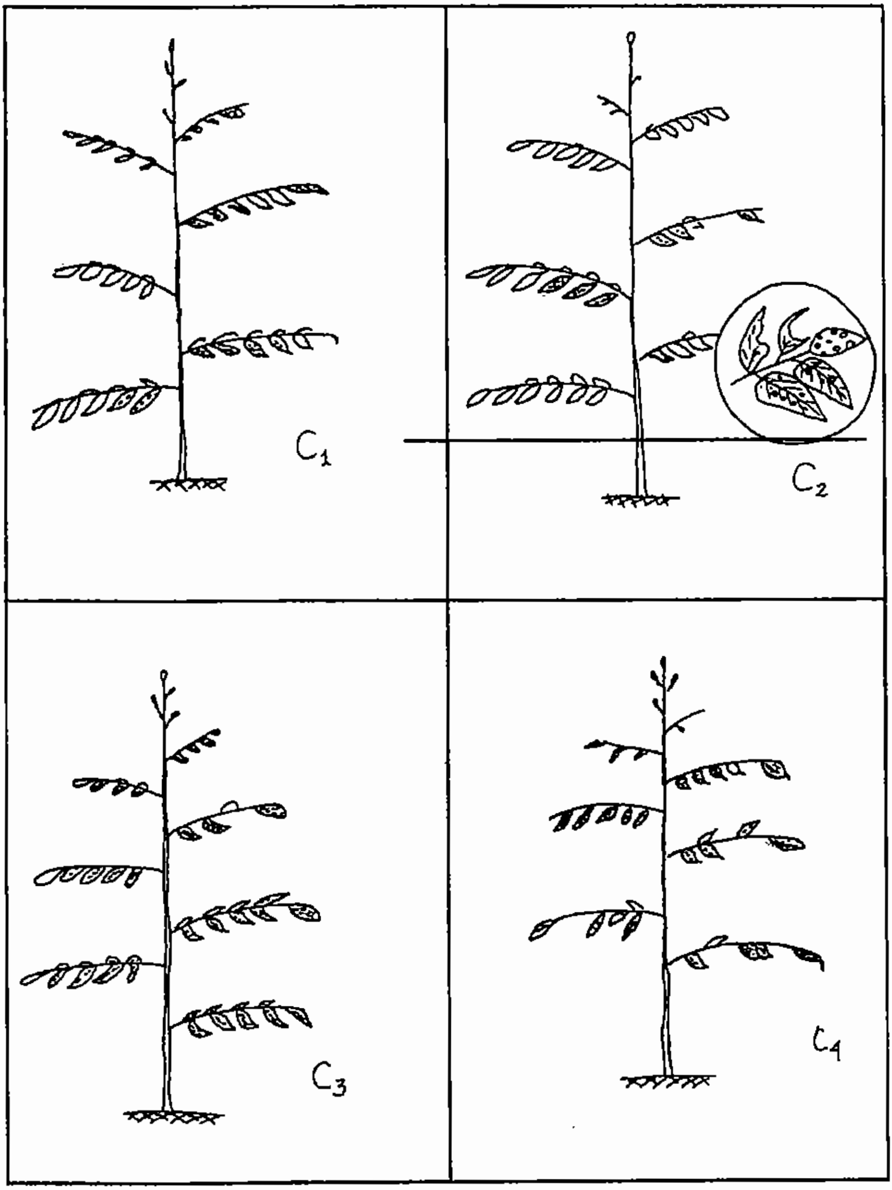

Figure 3. Diagramatic illustration indicating scoring system used for damages on the foliagage part of seedling (see scoring system)

Figure 4. Dead apical shoot causing new shoot taking over the old fork.

The percentage of damage recorded on leaves of 50-75%% of total foliage (Fig. 3) was observed in natural regeneration (28.6%), and this followed by line planting under macaranga (24.00%), line planting under natural forest (19.70%), gap planting (13.47%), nurse planting (1.71%). The percentage of same damage but occurred 25-50% of total foliage (Fig. 3) were 39.43% (gap planting), 33.30% (natural regeneration), 15.80 % (line planting under natural forest), 14.80 (line planting under macaranga), 12.22% (nurse planting). Broken or dead branches and defoliation are other damages recorded in the planting systems with varying intensity and severity. Specific causal agents of damage were not identified through the coding system.

As stated before that pest and disease signs and symtoms are prioritized and recorded based on the location and tipe of damage. Damage of main stem (A) in seedling and/or sapling will cause higher disturbance (bole quality) compare to that of branche (B) and/or foliage (C). When population is taken into account, high proportion of C4, for example, does not necceseraly result higher disturbance compare to even the small proportion of A2.

Assessment of pest and disease status of early growth, *i.e.* the growth of seedling and sapling, enable pridiction of the tree and stand growth and development. Therefore, survival and growth quality during the seedling and sapling growth stage need to be assessed specifically. The coding system developed in this experiment should be periodically checked for long-term detection of change, so that the over all assessment could be formulated and standardized.

CONCLUSIONS

1. The coding system developed in this experiment could accomodate and quantify pest and disease status of *Shorea* spp. seedling in the field, and the scores are repeatable. It is possible using this coding system to evaluate growth development of seedling and predict the growth quality of stand.

2. Higher seedling mortality recorded in all planting systems compared to that in natural forest indicates that the planting systems do not provide optimum habitat yet for *Shorea* spp. seedlings. Even under pioner stage of tropical forest dominated by macaranga *Shorea* seedlings did not performed well growth.

Acknowledgment

The authors would like to express their gratitude to Kansai Electric Power Company-Japan for supporting funds and facilities under Joint Research KEEC-UGM to conduct this research. They would like to expres their sincere thanks to Mr. Asih Prihatno for his kind help in the field.

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